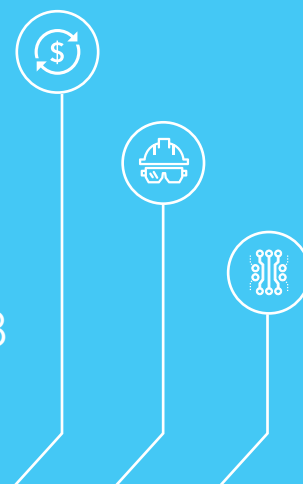


THE STATE OF SAFETY

The outlook for the oil and gas industry in 2018



In this report, we showcase key findings and insights from DNV GL's 2018 Industry Outlook research, including how:

- close to half (46%) of senior industry professionals believe that too little has been invested in safety in recent years - yet less than a third (28%) will increase safety spending in 2018
- under four-in-ten say safety management is effective and does not need to change
- 40% of respondents believe digital tools and technologies have already improved safety over the past three years.

In late November 2016, two workers tried to operate a 30-year-old valve at an oil refinery in Baton Rouge, Louisiana. The hand wheel was faulty so, following standard practice, the workers began to remove it so they could operate the valve beneath with a wrench. When they removed the bolts, a cloud of isobutane was released. A welding machine located 70 feet (21 metres) away ignited the vapours and the ensuing explosion injured four workers, two of them severely.¹

The oil and gas industry has become considerably safer over the past two decades according to data from several industry bodies, such as the

International Association of Oil & Gas Producers (IOGP),² as well as national associations, including those in the UK,³ Norway,⁴ US⁵ and Australia.⁶

Despite this, accidents like the one at Baton Rouge, which the US Chemical Safety Board found to be preventable, still occur. So, is enough being done to further improve safety in the oil and gas industry? Have recent market dynamics negatively affected investments in enhancing safety performance? And how aware are industry leaders of safety risks and incidents?

1 ExxonMobil Refinery Chemical Release and Fire: <http://bit.ly/2vt69xD>

2 The IOGP has been collecting safety incident data from the upstream industry globally since 1985. Across all the headline indicators, including fatalities, recordable injuries and lost time injuries, IOGP data shows a clear improving trend in the years from 2007 to 2016: <http://bit.ly/2qN66Y6>

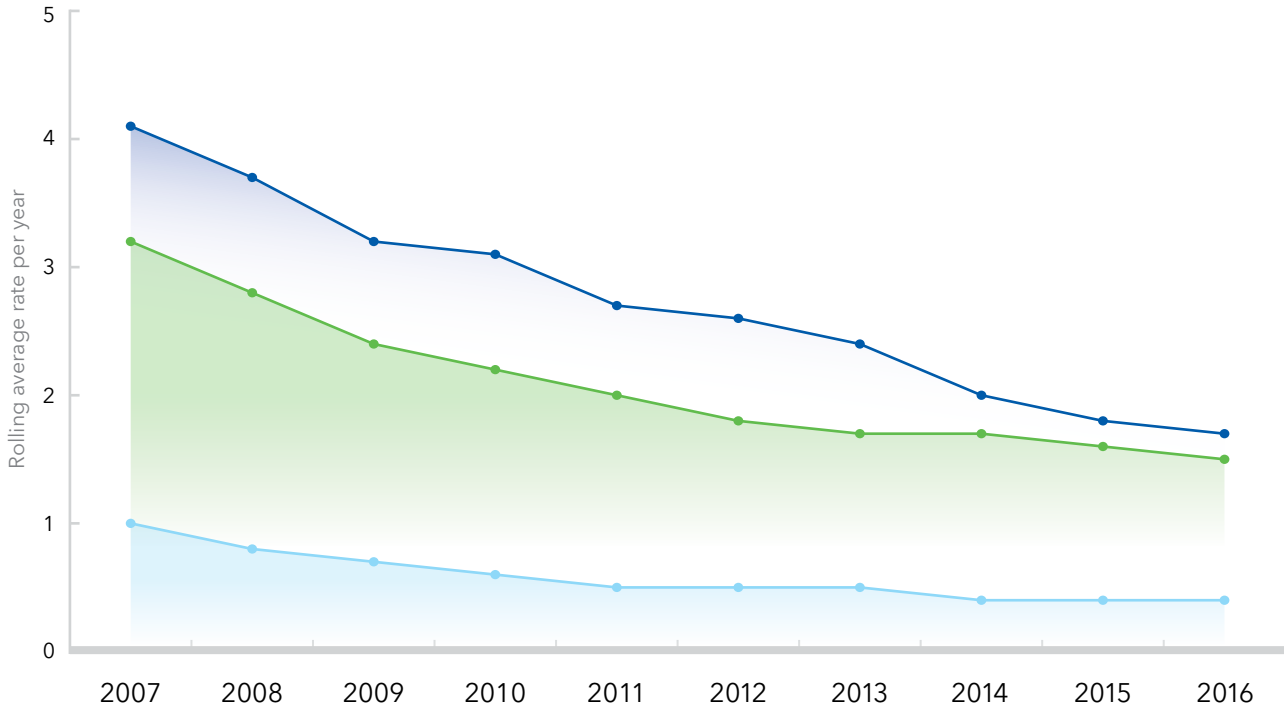
3 Health & safety report 2017: <http://bit.ly/2qMRKHe>

4 Injuries on permanently placed facilities: <http://bit.ly/2qRRu9Z>

5 Occupational Fatalities During the Oil and Gas Boom: <http://bit.ly/2qNxkh3>

6 Health, safety and environment report 2015-2016: <http://bit.ly/2qO29SL>

IOGP Safety Performance Indicators



Source: IOGP Safety Performance Indicators 2016 ■ Lost time injury frequency ■ Total recordable injury rate ■ Fatal accident rate

Industry divided on key issues

According to the results of DNV GL's 2018 Industry Outlook research, close to half (46%) of the 813 senior oil and gas professionals we surveyed believe that too little has been invested in maintenance and inspection of installations and equipment in recent years. Some 38% said that safety management in the oil and gas industry is effective and does not need to change - 26% disagree, while 31% are neutral.⁷ This clearly shows that the industry is divided on the need to change safety practices.⁸ The split comes through in many areas of our research, and depends, to an extent, on the respondents' region, job role and place in the value chain, as you can see from several of the charts included in this report.

It is also interesting to note how safety performance and investment evolved during the strong growth years to 2014, and then through the challenging years that followed. Just like the views of our survey respondents, authorities in different countries have come to varying conclusions on the impact of the downturn on safety.

For instance, data from the US Bureau of Labor Statistics shows that the rate of fatalities in the US oil and gas extraction industry decreased significantly between 2003 and 2013, even though the number of extraction workers doubled. So, although the number of fatalities increased with the growth in activity, the frequency of incidents per 100,000 workers fell.⁹

Similarly, in the UK, industry statistics published by Oil & Gas UK show that, while maintenance backlog in the UK offshore sector rose by 15% in 2016, there is no clear link between the oil price and asset integrity issues. In fact, the data shows that backlog was rising even when the oil price was high.¹⁰

At the same time, there have been indications in other regions that cost cutting has led to an increase in risk. In late 2016 in Norway, for example, the Petroleum Safety Authority Norway pointed to "several serious incidents" and launched a full review into safety in the industry, citing the fact that parties involved "disagree on whether cost reductions are putting pressure on safety."¹¹

7 The remaining 5% selected "don't know/not applicable"

8 The survey questions asked about safety in general, including both process and occupational safety

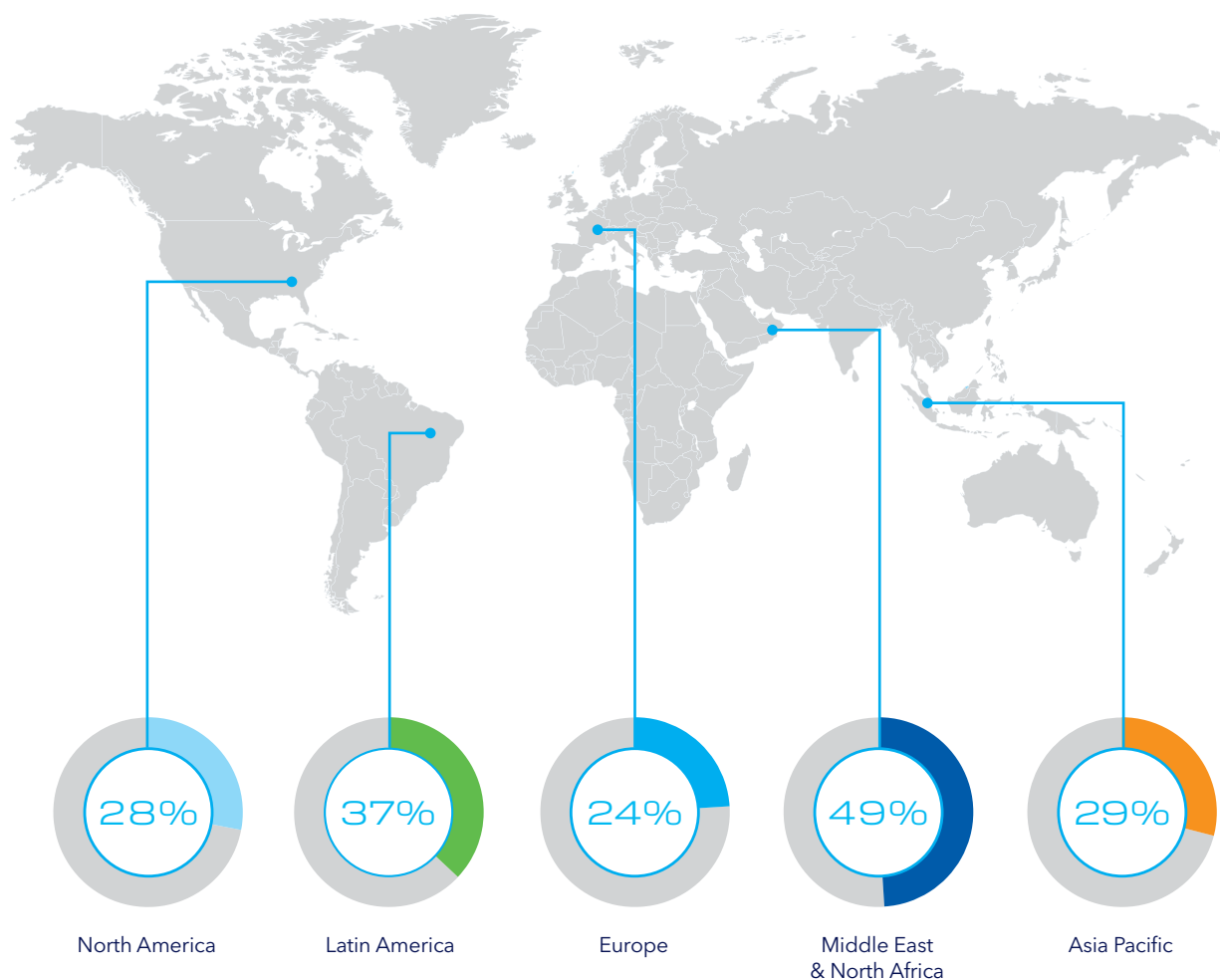
9 Occupational Fatalities During the Oil and Gas Boom: <http://bit.ly/2qNxxh3>

10 Health & safety report 2017: <http://bit.ly/2qMRKHe>

11 Minister Hauglie, new white paper on petroleum safety: <http://bit.ly/2qLSCvD>

The variation of safety spending

Percentage of respondents who expect to increase safety spending in 2018, by region



Certainly, many in the industry do not believe that their business has made any compromises on safety. "I think there is still a tremendous focus on safety in the industry as a whole," says Eirik Wærness, senior vice president and chief economist at Statoil. "We have not seen any kind of correlation between spending in any given year and the safety results."

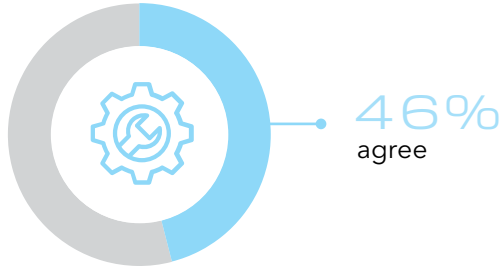
Our survey respondents mostly agree: 49% do not think that the focus on profitability in recent years has negatively impacted on safety performance, while 20% feel that it has. It is arguably too early to tell. The effects of cost cutting on safety can take time to have an impact.

"We have not seen any kind of correlation between spending in any given year and the safety results."

Eirik Wærness, senior vice president and chief economist, Statoil

"The risk that we've got now, in the recovering market, is that companies can forget about the underinvestment that they made," says Graham Bennett, vice president, DNV GL - Oil & Gas. "Ramping up operations to take new opportunities can result in a worrying picture if companies don't recognize the underinvestment made in the last few years. There is always a lag between periods of underinvestment and any associated safety impact."

The industry has invested too little in inspection and maintenance of installations and equipment in recent years



Just under a third (28%) of our survey respondents will increase spending on safety in 2018. At the same time, 61% will maintain current budgets and only 5% plan to reduce safety spending. The more optimistic respondents were about their organization’s prospects (38%) and industry growth (36%) in 2018, the more likely they were to be increasing spending on safety than the pessimists (17% and 18% respectively). This suggests a correlation between business success and investment in safety.

“There is always a lag between periods of underinvestment and any associated safety impact.”

Graham Bennett, vice president, DNV GL – Oil & Gas

Downstream sector set to invest more in safety

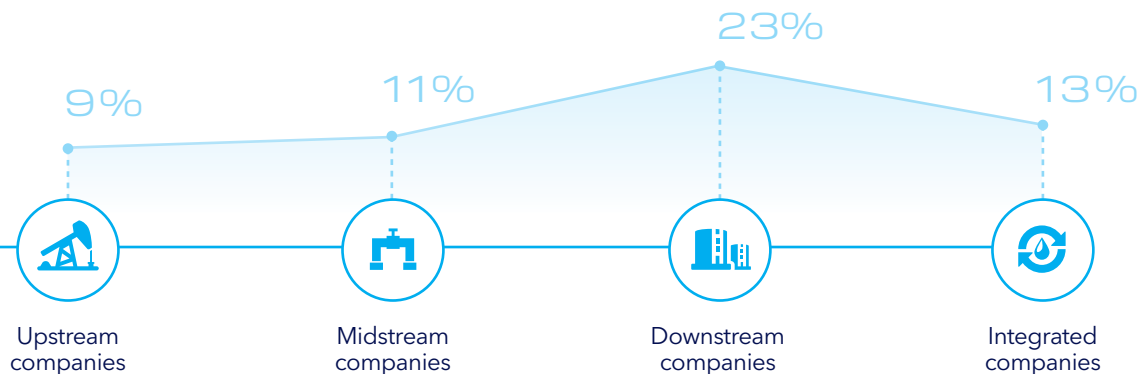
In our survey, respondents from the downstream sector currently expect the highest increase in safety spending (41%) this year, compared with other parts of the industry. We also find the downstream sector to be more concerned about safety than other areas of the value chain. For instance, only 12% of respondents overall say that cost cutting over the past three years has increased health and safety risk, but this figure is nearly double (23%) in the downstream sector.

From a regional perspective, respondents from China’s downstream sector (47%) were considerably more likely to say that their organization will be increasing spending on safety in 2018, compared with 27% in the US, 19% in Norway and just 14% in Australia.

“In China, the government has become highly concerned with safety issues in the refinery and petrochemicals industries in recent years,” says Mr Lu Nianming, Secretary-General of the China Chemical Safety Association (CCSA). Despite a sharp reduction in the overall number of incidents in the refining, petrochemicals and other chemical industries in China, the total is still high and China’s society is developing a low tolerance for poor worker safety. “As a result, petrochemical industries have had to invest more on safety measures despite profits sliding,” says Mr Lu Nianming. “Government monitoring has improved and, when incidents do happen, facilities are ordered to immediately stop production.”

Impact of cost cutting on safety

Percentage of respondents who agree that cost cutting has increased health and safety risk over recent years, by sector



Digital safety measures increasing

Many new investments in safety will be aimed at digitalizing safety monitoring, processes and responses this year. A clear finding from our survey is a significant increase in the proportion of respondents (54%) who intend to boost spending on digitalization in 2018 – up from 39% expected for 2017. Looking further ahead, over the next five years, 76% of respondents say they will invest in digitalization.

Already, even where cutbacks have been widespread, 40% say digitalization has improved safety over the past three years. “The industry has been a quick adopter of new technology and digitalization,” says Mr Lu Nianming. “Technology has helped us improve safety monitoring systems, data analytics helps us determine which processes, areas and equipment are more accident-prone, while we have wearable equipment to monitor workers in case they faint or fall.”

A key advantage of digitalization in the safety context is that it can allow for the integration and transparent communication of hundreds of key indicators from across an organization. For example, DNV GL’s MyQRA service draws on data from quantitative risk assessment (QRA) reports to create a single source of safety data that can help all stakeholders generate deeper safety insights, better understand important safety signals, make decisions and predict future outcomes.¹²

“For years, oil and gas companies have produced large volumes of data that has been crunched regularly to demonstrate compliance with safety regulations through quantitative and qualitative safety studies,” says Koheila Molazemi, global service area leader for risk management advisory, DNV GL – Oil & Gas. “Digital technologies are now helping us to unlock the value of this data, so that it can be used to go beyond reporting compliance, and provide insight that helps industry professionals better understand hazards, make critical decisions and communicate risk across the lifecycle of a project.”

The impact of digitalization

Percentage of respondents who agree that digitalization and new technology have improved safety in their organization over the past three years



The company is also digitalizing its International Safety Rating System (ISRS) service to make it easier for organizations to understand safety management performance. ISRS is a more qualitative assessment, built around the concept of process maturity, and works as an ideal complement to more quantitative assessments like QRAs.¹³

Digital corrections and advanced analytics

The appeal of digitalization is often how it compensates for human error – identified as the main cause of 60% to 80% of industrial accidents^{14,15} – and how well digital systems can manage and spread information. For example, in 2016 a report from BP suggested that there was no “standard and global approach to managing engineering information and data throughout the life of an asset” at the organization, and that this leads to “a consistent lack of clear accountability and responsibility for managing critical engineering information.”¹⁶

12 DNV GL brings QRA studies into the digital age with new dynamic reporting service: <http://bit.ly/2qMfdrS>

13 Delivery of safety management system assessments: <http://bit.ly/2qMfmLW>

14 The role of human error in accidents within oil and gas industry in Bahrain: <http://bit.ly/2qMfN92>

15 Improving Human Performance: <http://bit.ly/2qJ23vM>

16 Financial Times: <https://on.ft.com/2qMsoZT>

Despite the considerable benefits of digitalizing oil and gas systems and implementing stronger, integrated data management practices, modernization also brings new risks to be managed. “Companies will try this out cautiously, as there’s a lot of cyber security issues,” says Wærness of Statoil, “But we will see interesting developments here in terms of the use of sensors and surveillance technology to increase safety.”

As the industry adopts a growing portfolio of new technologies with an increasing digital dimension, it also faces the significant task of demonstrating that these are as safe as their mechanical and hydraulic counterparts. “Where the oil and gas industry has traditionally relied on mechanical and hydraulic safety barriers, it may increasingly rely on more efficient and cost-effective electric solutions and digital barriers in the future,” says Frank Børre Pedersen, programme director, DNV GL Group Technology and Research. “We see all-electric solutions attracting substantial interest and opportunities relating to using digitalization to simplify process control and process subsea safety. However, existing standards and guidelines, derived from best practices for traditional technologies and operational concepts, may not be relevant for demonstrating the safety of such new concepts.”

“Where the oil and gas industry has traditionally relied on mechanical and hydraulic safety barriers, it may increasingly rely on more efficient and cost-effective electric solutions and digital barriers in the future.”

Frank Børre Pedersen, programme director,
DNV GL Group Technology and Research

A consortium of eight companies recently joined the Norwegian University of Science and Technology and the University of Stavanger to collaborate on a DNV GL-led joint industry project that is beginning to tackle this issue. The Safety 4.0 project, due to begin this year, will explore new fail-safe philosophies in the subsea sector and develop a best practice framework for introducing new technology solutions within the frames of Norway’s existing safety requirements.

Senior executives are more positive about safety

Encouragingly, most survey participants (85%) say that safety risks and incidents are reported to senior management, and this figure rises to 91% among

those working for companies with an annual revenue over USD500m. But how do perspectives on safety differ between those closer to the boardroom and those closer to the hazards?

Our survey found:

- senior management (45%) are more likely than engineers and technical specialists (32%) to say safety management is effective and does not need to change
- nearly twice as many engineers/technical specialists (28%) as business leaders (15%) say that a focus on profitability has had a negative impact on safety performance
- most business leaders (65%) say that senior management understand the impact of cost cutting on safety, while just 50% of engineers and technical specialists say the same.

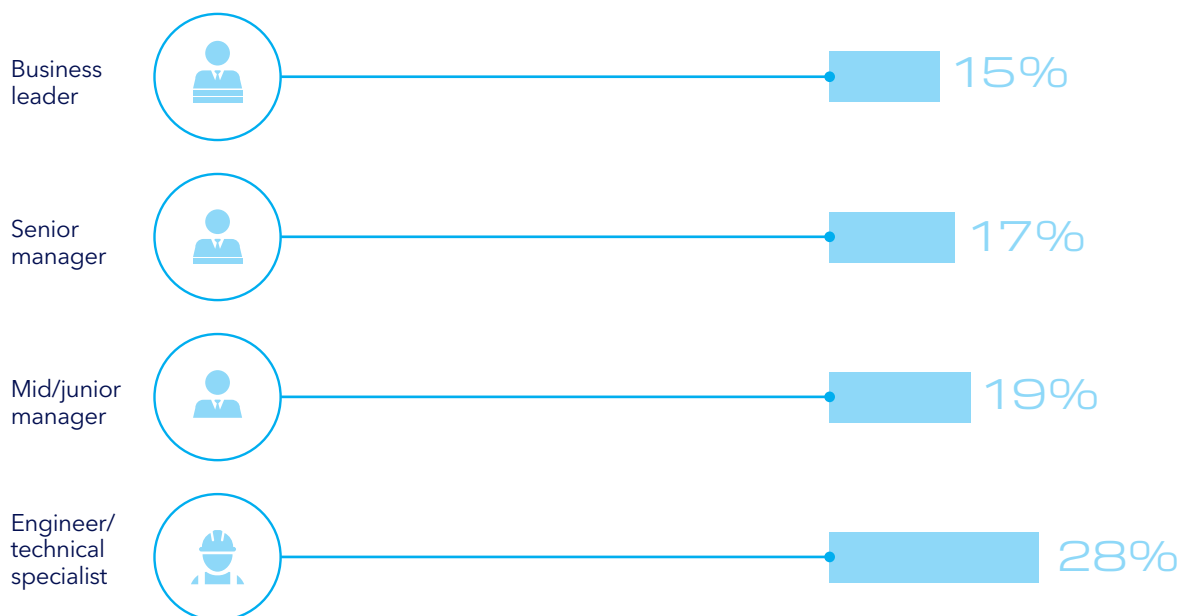
This indicates that those in the boardroom are, to some degree, more optimistic about safety than those in the field. While further research is needed to understand why this is the case, it suggests that senior leaders in the oil and gas industry could benefit from spending time better understanding the risks faced by those on the front line.

Demand for hazard awareness training courses at DNV GL’s Spadeadam Testing and Research Centre in northern England has been strong despite the challenging economic climate of recent years. The courses help to reduce organizational divergence in safety awareness and communications by providing attendees with an opportunity to gain a basic understanding of fires, explosions and other hazards through live demonstrations (complementing classroom-based theory). Some oil and gas operators intentionally ask employees from less obvious areas of the business – including office-based management and finance teams – to attend the courses.

“Lots of people have studied major hazards in workshops and classes, but it is only when they see and, more importantly, feel the effects of hazards, that they really become aware of what is at stake and the importance of their role in preventing future incidents,” says DNV GL’s Graham Bennett. “Our demonstrations allow delegates to experience the intensity of the heat, hear deafening explosions and see how quickly and easily disaster can strike. We are now developing and rolling out virtual reality (VR) versions of the training so that more people can experience it.”

The effect of profit-focus on safety performance

Percentage of respondents who agree that the focus on profitability in recent years has had a negative effect on safety performance in their organization, by job role



The right mindset: perpetual improvement

Overall, long-term trends indicate a strong improvement in the safety of oil and gas industry workers over time. The industry appears to be largely continuing this path, increasing investment and modernising safety procedures and equipment. However, there are reasons to caution the optimism - from lower investment in safety in recent years, to the relatively higher concerns identified in the downstream sector, and by more junior and technical employees.

"Operators cannot afford not to maintain safety - they are aware, of course, that they can't compromise in this area - I don't really believe they are allowing maintenance or safety standards to slip," says Frank Ketelaars, regional manager, Americas at DNV GL - Oil & Gas. "In fact, in many places the pressure to raise standards has increased. At the same time, there are definitely areas that can be improved."

In our example from Baton Rouge, for instance, the investigation (by the US Chemical Safety Board) found that workers were unaware that the type of valve they were operating was one of just 3% at the plant that had not been upgraded to a safer design.

A simple sign, label or brief instruction could have alerted them to this, and to the fact that the four bolts they removed held, not only the handwheel bracket, but also critical pressure-containing components.

"In many places the pressure to raise standards has increased. At the same time, there are definitely areas that can be improved."

Frank Ketelaars, regional manager, Americas, DNV GL - Oil & Gas

While zero risk is unachievable, much more can be done to stop preventable incidents like this one. "We are in an industry that involves risks," says Wærness. "Safety incidents will happen no matter how much we do, but we can work to get the rate of incidents as low as possible. And to do that we must constantly focus on the need for improvements."

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ABOUT DNV GL

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As the technical advisor to the oil and gas industry, we bring a broader view to complex business and technology risks in global and local markets. Providing a neutral ground for industry cooperation, we create and share knowledge with our customers, setting standards for technology development and implementation. From project initiation to decommissioning, our independent experts enable companies to make the right choices.

For more information on DNV GL's Industry Outlook research, visit: <https://dnvgl.com/industryoutlook2018>